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PATENT ABSTRACTS OF JAPAN

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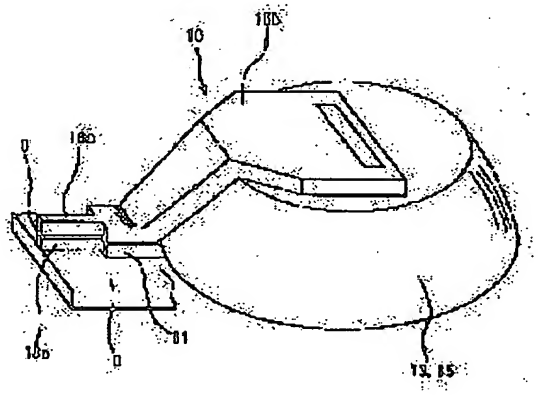
(71)Applicant : TDK CORP
(72)Inventor : SASAKI YOSHITAKA

(54) THIN FILM MAGNETIC HEAD AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To make it possible to correctly control the magnetic pole width, to obtain satisfactory overwriting characteristics, and to make correctly controllable the throat height even in the case of reducing the magnetic pole width.
SOLUTION: A magnetic pole part 18a and an insulated layer 11 of a lower magnetic pole layer are formed on a yoke part 8 of the lower magnetic layer. The throat height is decided by a boundary between the magnetic pole part 18a and the insulated layer 11. Also, a flat surface is formed on the side of a recording gap layer 9 with the magnetic pole part 18a and the insulated layer 11. A magnetic pole part 16a having a depth deciding a recording track width and a yoke part 16b which is magnetically connected to the magnetic pole part 16a and has a larger width than that of the magnetic pole part 16a are included in an upper magnetic pole layer 16. A boundary between the magnetic pole part 16a and the yoke part 16b is arranged on the flat recording gap layer 9.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The 1st and 2nd magnetic layers which consist of at least one layer including two magnetic pole portions which the part of the side which is connected magnetically and counters a record medium counters through a gap layer, respectively The induction-type MAG sensing element for writing which has the thin film coil arranged in th state where it insulated between these the 1st and 2nd magnetic layers It is the thin film magnetic head equipped with the above. the 1st magnetic layer of the above The 1st magnetic pole portion and the 1st yoke portion magnetically connected with this 1st magnetic pole portion are included. the 2nd magnetic layer of the above It connects with the 2nd magnetic pole portion which has the width of face which determines recording track width of face, and this 2nd magnetic pole portion magnetically. While determining throat height in contact with the magnetic pole portion of the above 1st further including the 2nd yoke portion which has larger width of face than the 2nd magnetic pole portion It has the insulating layer which forms a flat field in a gap layer side, and the border area of th magnetic pole portion of the above 2nd and the 2nd yoke portion is characterized by being arranged in the position which counters the flat field formed of the magnetic pole portion and the aforementioned insulating layer of the above 1st.
[Claim 2] The edge by the side of the 2nd [of the yoke portion of the above 2nd] magnetic pole portion is the thin film magnetic head according to claim 1 characterized by having made the predetermined angle and having spread to the crosswise outside to the edge of the 2nd magnetic pole portion.
[Claim 3] The aforementioned predetermined angle is the thin film magnetic head according to claim 2 characterized by being 90 degrees substantially.
[Claim 4] The border area of the magnetic pole portion of the above 2nd and the 2nd yoke portion is the thin film magnetic head according to claim 1 to 3 characterized by being arranged in the position corresponding to the bord r ar a of the magnetic pole portion of the above 1st, and the aforementioned insulating layer.
[Claim 5] The magnetic pole portion of the above 1st and the 1st yoke portion are the thin film magnetic head according to claim 1 to 4 characterized by the bird clapper from a separate layer.
[Claim 6] The magnetic pole portion of the above 2nd and the 2nd yoke portion are the thin film magnetic head according to claim 1 to 5 characterized by the bird clapper from one layer.
[Claim 7] The aforementioned thin film coil is the thin film magnetic head according to claim 1 to 6 characterized by being arranged between the aforementioned gap layer and the yoke portion of the above 2nd.
[Claim 8] The aforementioned thin film coil is the thin film magnetic head according to claim 1 to 6 characterized by being divided and arranged between between the aforementioned gap layer and the yoke portions of the above 1st, the aforementioned gap layer, and the yoke portion of the above 2nd.
[Claim 9] The 1st and 2nd magnetic layers which consist of at least one layer including two magnetic pole portions which the part of the side which is connected magnetically and counters a record medium counters through a gap lay r, respectively The induction-type MAG sensing element for writing which has the thin film coil arranged in th state where it insulated between these the 1st and 2nd magnetic layers While being the manufacture method of th thin film magnetic head equipped with the above and forming the 1st magnetic layer containing the 1st magnetic pole portion and the 1st yoke portion magnetically connected with this 1st magnetic pole portion The 1st process which forms the insulating layer which forms a flat field in a gap layer side while determining throat height in contact with the magnetic pole portion of the above 1st, The 2nd process which forms a gap layer on the magnetic pole portion of the above 1st, and the aforementioned insulating layer, The 3rd process which forms a thin film coil so that at least a part may be arranged on the aforementioned gap layer, The 4th process which forms the 2nd magnetic layer on the aforementioned gap layer and a thin film coil is included. the 2nd magnetic layer of the abov It connects with the 2nd magnetic pole portion which has the width of face which determines recording track width of face, and this 2nd magnetic pole portion magnetically. At the 4th process of the above, it is characterized by arranging the border area of the magnetic pole portion of the above 2nd, and the 2nd yoke portion in the position which counters the flat field formed of the magnetic pole portion and the aforementioned insulating layer of th above 1st including the 2nd yoke portion which has larger width of face than the 2nd magnetic pole portion.
[Claim 10] The manufacture method of th thin film magnetic h ad according to claim 9 charact rized by forming the 2nd magnetic layer so that the edge by the side of the 2nd [of the yok portion of th above 2nd] magn tic pol portion may mak a predetermin d angl and may spread to a crosswis outside to the edg of th 2nd magnetic pole portion at the 4th process of th above.
[Claim 11] The manufacture m thod of th thin film magnetic h ad according to claim 10 characterized by making

the aforementioned predetermined angle into 90 degrees substantially.
[Claim 12] The manufacture method of the thin film magnetic head according to claim 9 to 11 characterized by arranging the border area of the magnetic pole portion of the above 2nd, and the 2nd yoke portion in the position corresponding to the border area of the magnetic pole portion of the above 1st, and the aforementioned insulating layer at th 4th process of the above.
[Claim 13] The manufacture method of the thin film magnetic head according to claim 9 to 12 characterized by forming the magnetic pole portion of the above 1st, and the 1st yoke portion by th separate layer at the 1st process of the above.
[Claim 14] The manufacture method of the thin film magnetic head according to claim 9 to 13 characterized by forming the magnetic pole portion of the above 2nd, and the 2nd yoke portion by one layer at the 4th process of th above.
[Claim 15] The manufacture method of the thin film magnetic head according to claim 9 to 14 characterized by arranging the aforementioned thin film coil between the aforementioned gap layer and the yoke portion of the above 2nd at the 3rd process of the above.
[Claim 16] The manufacture method of the thin film magnetic head according to claim 9 to 14 characterized by dividing and arranging the aforementioned thin film coil at the 3rd process of the above between between the aforementioned gap layer and the yoke portions of the above 1st, the aforementioned gap layer, and the yoke portion of the above 2nd.
[Claim 17] The manufacture method of the thin film magnetic head according to claim 9 to 16 characterized by forming an insulating layer and carrying out flattening processing of the upper surface of the 1st magnetic layer and an insulating layer after that at the 1st process of the above after forming the 1st magnetic layer.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the thin film magnetic head which writes in at least and has the induction-type MAG sensing element of business, and its manufacture method.
[0002]
[D scription of the Prior Art] In recent years, the improvement in a performance of the thin film magnetic head is called for with improvement in the field recording density of a hard disk drive unit. The compound-die thin film magnetic head of the structure which carried out the laminating of the reproducing head which reads as the thin film magnetic head with the recording head which has an induction-type MAG sensing element for writing, and has the magnetic-reluctance (it is hereafter described as MR (Magneto Resistive).) element of business is used widely. There are an AMR element using the anisotropy magnetic-reluctance (it is hereafter described as AMR (Anisotropic Magneto Resistive).) effect as a MR element and a GMR element using the huge magnetic-reluctance (it is hereaft r described as GMR (Giant Magneto Resistive).) effect. It is only called an MR head and the AMR head or the reproducing head using the GMR element is called GMR head for the reproducing head using the AMR element. For the AMR head, field recording density is 1 gigabit / (inch) 2. It is used as the reproducing head which exceeds and, for a GMR head, field recording density is 3 gigabit / (inch) 2. It is used as the reproducing head which exceeds.
[0003] There are a method of changing MR film into the material or structure which was excellent in magnetic-r luctance sensitivity, such as the AMR film to a GMR film, as a method of raising the performance of the reproducing head, the method of optimizing MR height of MR film, etc. This MR height says the length (height) from the edge by the side of the pneumatic bearing side of MR element to the edge of an opposite side, and it is controlled by the amount of polishes in the case of processing of a pneumatic bearing side. In addition, the pn umatic bearing sides said here are the magnetic-recording medium of the thin film magnetic head, and a field which counters, and are also called truck side.
[0004] On the other hand, the improvement in a performance of a recording head is also called for with the improvement in a performance of the reproducing head. There is throat height (Throat Height:TH) as a factor which determines the performance of a recording head. Throat height says the length (height) from the edge by the sid of a pneumatic bearing side of the portion which two magnetic pole layers counter through a record gap layer to the edge of an opposite side. Reduction-ization of throat height is desired for the improvement in a performance of a r cording head. This throat height is also controlled by the amount of polishes in the case of processing of a pneumatic bearing side.
[0005] In order to raise recording density among the performances of a recording head, it is necessary to raise th track density in a magnetic-recording medium. It is necessary to realize the recording head of the ** truck structure which narrowed width of face in the pneumatic bearing side of the lower magnetic pole formed in the upper and lower sides on both sides of the record gap layer, and an up magnetic pole from several microns to submicron order, and for that, in order to attain this, semiconductor processing technology is used.
[0006] Here, with reference to drawing 13 or drawing 18 , an example of the manufacture method of the compound-die thin film magnetic head is explained as an example of the manufacture method of the conventional thin film magnetic head. In addition, in drawing 13 or drawing 18 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.
[0007] By this manufacture method, first, as shown in drawing 13 , the insulating layer 102 which consists of an alumina (aluminum 2O3) is deposited by the thickness of about about 5 micrometers on the substrate 101 which consists of ARUTIKKU (aluminum 2O3 and TiC). Next, the lower shield layer 103 for the reproducing heads which consists of a magnetic material is formed on an insulating layer 102 at the thickness of 2-3 micrometers.
[0008] Next, as shown in drawing 14 , on the lower shield layer 103, the spatter deposition of the alumina is carried out at the thickness of 70-100nm, and the lower shield gap film 104 as an insulating layer is formed. Next, MR film for forming the MR element 105 for r production on the lower shield gap film 104 is formed in the thickness of dozens of nm. Next, a photoresist pattern is alternatively formed in the position which should form the MR element 105 on this MR film. At this tim , the configuration which can perform a lift off easily, for example, a cross-section configuration, forms a T typ photoresist patt rn. N xt, MR film is ********** d by ion milling by using a photoresist pattern as a mask, for example, th MR element 105 is formed. In addition, a GMR lement is sufficient as the MR element 105, and the AMR l ment is sufficient as it. Next, th electrod layer 106 of the coupl electrically connected to the MR element 105 is formed in th thickness of doz ns of nm by using the photor sist

pattern same on the lower shield gap film 104 as a mask.
[0009] Next, the up shield gap film 107 as an insulating layer is formed on the lower shield gap film 104 and the MR element 105 at the thickness of 70-100nm, and the MR element 105 is laid underground in th shield gap film 104,107.
[0010] Next, as shown in drawing 15 , on the up shield gap film 107, it consists of a magnetic material and the lower [an up shield layer-cum-] magn tic pole layer (it is hereafter described as a lower magnetic pole layer.) 108 used to the both sides of the reproducing head and a recording head is formed at the thickness of about 3-3.5 micrometers. Next, the record gap layer 109 which consists of an insulator layer, for example, an alumina film, is formed on the lower magnetic pole layer 108 at the thickness of 0.2-0.3 micrometers.
[0011] Next, as shown in drawing 16 , for magnetic-path formation, the record gap layer 109 is **********ed partially and a contact hole 119 is formed. Next, the photoresist layer 110 which determines throat height on the record gap layer 109 is formed in a predetermined pattern by the thickness of about 2 micrometers. Next, the thin film coil 112 of the 1st layer for the recording heads of an induction type is formed on a photoresist layer 110 at the thickness of about 2 micrometers.
[0012] Next, as shown in drawing 17 , a photoresist layer 113 is formed on a photoresist layer 110 and a coil 112 at a predetermined pattern. Next, the thin film coil 114 of the 2nd layer is formed on a photoresist layer 113 at the thickness of about 2 micrometers. Next, a photoresist layer 115 is formed on a photoresist layer 113 and a coil 114 at a predetermined pattern. Next, in order to carry out flattening of the photoresist layer 115 top, it heat-treats at the temperature of about 250 degreeC.
[0013] Here, the portion which rose in the shape of [which is formed by the coil 112,114 and the photoresist layer 110,113,115] a mountain is called apex section. Moreover, the inclination by the side of the pneumatic bearing sid of this apex section is called apex angle. Generally an apex angle is 45 degrees - about 55 degrees. Formation of a recording track is attained by forming an up magnetic pole layer on the apex section.
[0014] Next, as shown in drawing 18 , the up magnetic pole layer 116 which consists of a permalloy (NiFe) of the magnetic material for recording heads, for example, high saturation-magnetic-flux-density material, or FeN is formed on the record gap layer 109 and a photoresist layer 113,115 at the thickness of about 0.5-1.0 micrometers. Besides, through a contact hole 119, the section magnetic pole layer 116 contacted the lower magnetic pole layer 108, and is connected magnetically.
[0015] Next, it **********s by ion milling by using the up magnetic pole layer 116 as a mask in a part of record gap layer 109 and lower magnetic pole layer 108. Next, the overcoat layer 117 which consists of an alumina is formed on th up magnetic pole layer 116, flattening of the front face is carried out, and the pad for electrodes which is not illustrated is formed on it. Finally, a slider is machined, the pneumatic bearing side of a recording head and the reproducing head is formed, and the thin film magnetic head is completed. As shown in drawing 18 (b), the structur where some each side attachment walls of the up magnetic pole layer 116, the record gap layer 109, and the lower magnetic pole layer 108 were perpendicularly formed in the self-adjustment target is called trim (Trim) structure. According to this trim structure, the increase in the effective width of recording track by the breadth of the magnetic flux generated at the time of the writing of a ** truck can be prevented.
[0016] Drawing 19 is the plan of the thin film magnetic head manufactured as mentioned above. In addition, the overcoat layer 117 is omitted in drawing 19 . As shown in drawing 19 , the up magnetic pole layer 116 has magnetic pole partial 116a arranged at the pneumatic bearing side 120 side, and yoke partial 116b arranged in the position which counters a coil 112,114. The width of face of magnetic pole partial 116a determines recording track width of face. The part by the side of magnetic pole partial 116a in yoke partial 116b is formed in the shape of [to which th magnetic pole partial 116a side becomes thin] a taper. The rim of the portion of the shape of this taper is making 45 degrees as opposed to the field parallel to the pneumatic bearing side 120. Among drawing, in order that sign 108a may consider as trim structure, the lower magnetic pole layer 108 expresses the portion into which it **********s.
[0017] In addition, by the following explanation, the position of the edge by the side of the pneumatic bearing side of the insulating layer which determines throat height is called throat height zero position, and it expresses with a sign TH0.
[0018]
[Problem(s) to be Solved by the Invention] In order to enable high surface density record in recent years, it is required that recording track width of face (henceforth magnetic pole width of face), i.e., the width of face of a magnetic pole portion, should be made small, for example, submicron order or width of face not more than it which is 0.5 micrometers is desired. There is technology of dividing and forming an upper part [former] magnetic pole layer in a magnetic pole portion and a yoke portion as technology for realizing such narrow magnetic pole width of face.
[0019] By the way, as a method of forming an up magnetic pole layer, as shown in JP,7-262519,A, the frame galvanizing method is used, for example. When forming an up magnetic pole layer using the frame galvanizing method, on th whol , th thin electrode lay r which consists of a permalloy is first formed by sputtering on the ap x section which is th coil portion which ros in the shape of a mountain. N xt, on it, a photor sist is applied, patt rning is carri d out according to a photolithography proc ss, and th fram for plating (outer frame) is formed. And an up magn tic pole layer is formed by th galvanizing method by using as a seed lay r the el ctrod layer formed previously.
[0020] Howev r, ther is th differenc of elevation 7-10 micrometers or mor in the apex s ction and oth r portions, for example. On this apex section, a photor sist is applied by th thickness of 3-4 micromet rs. Supposing

the thickness of the photoresist on the apex section is at least 3-micrometer or more need, since the photoresist with a fluidity gathers for the method of a low, in the lower part of the apex section, a photoresist film with a thickness of 8-10 micrometers or more will b formed, for example.
[0021] In order to realize recording track width of face of submicron order as mentioned above, it is nec ssary to form the frame pattern of th width of face of submicron order with a photoresist film. When dividing and forming an up magnetic pole layer in a magnetic pole portion and a yoke portion and recording track width of fac becomes submicron order, it is necessary to form not only a magnetic pole portion but a yoke portion by submicron order. Therefore, you have to form the detailed pattern of submicron order on the apex section with a photoresist film with the thickness of 8-10 micrometers or more. However, it was very difficult on the manufacturing process to form th photoresist pattern of such thick thickness by ** pattern width of face.
[0022] And at the time of exposure of a photolithography, the light for exposure reflects by the ground electrode layer as a seed layer, a photoresist exposes, collapse of a photoresist pattern etc. arises and a sharp and exact photoresist pattern is no longer obtained by this reflected light.
[0023] Thus, when magnetic pole width of face became submicron order conventionally, there was a trouble that it b came difficult to form an up magnetic layer with a sufficient precision. Moreover, even when an up magnetic pol layer was divided and formed in a magnetic pole portion and a yoke portion, there was a trouble that it became difficult to form a yoke portion in the position corresponding to a magnetic pole portion with a sufficient precision.
[0024] For example, 5-10GB/(inch)2 From the thin film magnetic head which has high field recording density, throat h ight is 0.6-0.9 micrometers, and specification which recording track width of face calls 0.7-1.0 micrometers (eff ctive magnetic-track width of face is 0.8-1.2 micrometers) is required. However, it was difficult to control magnetic pole width of face by the conventional technology for an above-mentioned reason to be set to 0.7-1.0 micrometers (for effective magnetic-track width of face to be 0.8-1.2 micrometers).
[0025] Moreover, as conventionally shown in drawing 19 , the portion from which the border area of magnetic pole partial 116a of the up magnetic pole layer 116 and yoke partial 116b, i.e., the width of face of the up magnetic pol layer 116, changes was arranged to the apex section side rather than the throat height zero position TH0. This is because it is difficult to form latus yoke partial 116b of width of face on the slant face of the apex section.
H r after, the reason is explained. If yoke partial 116b of larger width of face than recording track width of face is formed on the slant face of the apex section, you have to change suddenly the width of face of the up magnetic pole layer 116 from the latus width of face in yoke partial 116b to the same width of face as the recording track width of face of submicron order in the position of the root of the apex section. However, when forming the up magnetic pole layer 116 using a photolithography, it was impossible to have changed width of face in this way. That is because it is the position of the root of the apex section and an exact photoresist pattern cannot be obtained by the reflected light from the slant face of the apex section at the time of exposure of a photolithography. Since the position of the root of the apex section is the throat height zero position TH0 conventionally, it is the throat height zero position TH0, and it will be said that width of face of the up magnetic pole layer 116 cannot be changed suddenly. It is from the throat height zero position TH0 that the width of face of magnetic pole partial 116a is correctly controllable from the position of 1-2-micrometer or more beyond in the pneumatic bearing side 120 side.
[0026] Therefore, throat height became long conventionally and there was a trouble that the write-in property call d flux rise time which expresses the time of the over-writing property which is a property in the case of carrying out overwrite of the data, a nonlinear transition shift (NLTS), and the standup of a magnetic field with the upper shell pan already written in on the record medium was not improvable.
[0027] Moreover, conventionally, since the border area of magnetic pole partial 116a of the up magnetic pole layer 116 and yoke partial 116b is arranged to an apex section side rather than the throat height zero position TH0 Near the throat height zero position TH0, volume sufficient as an up magnetic pole layer 116 was not obtained, but magnetic flux was saturated near the throat height zero position TH0, and the phenomenon in which it became impossible for magnetic flux to fully reach to the nose of cam of a magnetic pole portion had occurred. As a result (th effective width of recording track is 1.0 micrometers), for example, recording track width of face of 0.8 micrometers, the value which shows an over-writing property turned into about 15-20dB and a low value, and th re was a trouble that sufficient over-writing property was not securable. In addition, as an over-writing property, about 25-35dB is required.
[0028] Moreover, in the conventional thin film magnetic head, although the photoresist layer surrounding a coil has determined throat height, in two or more head elements formed in a wafer with this same photoresist layer, the pattern array is not made correctly and uniformly. Since it will ********** together to the photoresist layer which has determined throat height in case it expands in case this photoresist layer is heat treatment, or the seed layer of a coil is **********ed by ion milling, the greatest reason is because it was difficult to arrange the position of the edge of the photoresist layer which determines throat height about two or more head elements arranged by the single tier. The alignment error of the pattern between two or more head elements arranged by the single tier is generated no less than 0.2-0.5 micrometers, when many.
[0029] Therefor , when th throat height of submicron order was required and polish processing of a pneumatic bearing side was conv ntionally perform d to the bar with which it was start d from the wafer and two or more head elem nts were arranged by th single ti r, th r was a trouble that many yield loss occurred by th h t rog neity of the throat height between h ad lements.
[0030] In addition, it arranges in the position which turned th nos of cam of an insulating layer in which a coil is formed to th back gap (portion which an up-and-down magnetic pol lay r contacts), and separat d it from th

throat height zero position at least 3 micrometers as a means of the densification of a recording track, or the thin film magnetic head which separated 10 micrometers or more of starting positions of a coil from the throat height zero position, and has arranged them is proposed by JP,8-877174,A. However, with such structure, magnetic-path length cannot become long, and neither the intensity of record magnetic field sufficient when the frequency of recording information is high, nor the chronocline of a standup can be obtained, but there is a trouble that the property of the thin film magnetic head deteriorates.

[0031] this invention was made in view of this trouble, and the purpose is to offer the thin film magnetic head which enabled exact control of throat height, and its manufacture method while making it possible exact control of magnetic pole width of face, and to acquire sufficient over-writing property, when magnetic pole width of face is made small.

[0032]

[Means for Solving the Problem] The 1st and 2nd magnetic layers which consist of at least one layer including two magnetic pole portions which the part of the side which the thin film magnetic head of this invention is connected magnetically, and counters a record medium counters through a gap layer, respectively, It is the thin film magnetic head equipped with the induction-type MAG sensing element for writing which has the thin film coil arranged in th state where it insulated between these the 1st and 2nd magnetic layers. the 1st magnetic layer The 1st magnetic pole portion and the 1st yoke portion magnetically connected with this 1st magnetic pole portion are included. the 2nd magnetic layer It connects with the 2nd magnetic pole portion which has the width of face which determines recording track width of face, and this 2nd magnetic pole portion magnetically. While determining throat height in contact with the 1st magnetic pole portion further including the 2nd yoke portion which has larger width of face than the 2nd magnetic pole portion It has the insulating layer which forms a flat field in a gap layer side, and the border area of the 2nd magnetic pole portion and the 2nd yoke portion is arranged in the position which counters the flat field formed of the 1st magnetic pole portion and insulating layer. In addition, in this application, a border area means the field which shows the boundary of two portions, and a field with a certain amount of breadth is also included like [when changing from one / the line which shows the boundary of two portions, or not only a cross section but / portion to the portion of another side gradually, in case the changing field is shown].

[0033] The 1st and 2nd magnetic layers which consist of at least one layer including two magnetic pole portions which the part of the side which the manufacture method of the thin film magnetic head of this invention is connected magnetically, and counters a record medium counters through a gap layer, respectively, It is the manufacture method of the thin film magnetic head equipped with the induction-type MAG sensing element for writing which has the thin film coil arranged in the state where it insulated between these the 1st and 2nd magnetic layers. The 1st magnetic pole portion, While forming the 1st magnetic layer containing the 1st yoke portion magnetically connected with this 1st magnetic pole portion The 1st process which forms the insulating layer which forms a flat field in a gap layer side while determining throat height in contact with the 1st magnetic pole portion, The 2nd process which forms a gap layer on the 1st magnetic pole portion and an insulating layer, The 3rd process which forms a thin film coil so that at least a part may be arranged on a gap layer, The 4th process which forms the 2nd magnetic layer on a gap layer and a thin film coil is included. the 2nd magnetic layer It connects with the 2nd magnetic pole portion which has the width of face which determines recording track width of face, and this 2nd magnetic pole portion magnetically. At the 4th process, the border area of the 2nd magnetic pole portion and the 2nd yoke portion is arranged including the 2nd yoke portion which has larger width of face than the 2nd magnetic pole portion in the position which counters the flat field formed of the 1st magnetic pole portion and insulating lay r.

[0034] By the thin film magnetic head or its manufacture method of this invention, while throat height is determined by the 1st magnetic pole portion and insulating layer of a magnetic layer, a flat field is formed in a gap layer side of them. [1st] And the border area of the 2nd magnetic pole portion which has the width of face which determines recording track width of face, and the 2nd yoke portion which has larger width of face than the 2nd magnetic pole portion is arranged in the position which counters the flat field formed of the 1st magnetic pole portion and insulating layer.

[0035] Moreover, the edge by the side of the 2nd [of the 2nd yoke portion] magnetic pole portion makes a predetermined angle, and it is made to spread to a crosswise outside to the edge of the 2nd magnetic pole portion, for example by the thin film magnetic head or its manufacture method of this invention. As for a predetermined angle, it is desirable that it is at 90 degrees substantially.

[0036] Moreover, by the thin film magnetic head or its manufacture method of this invention, the border area of th 2nd magnetic pole portion and the 2nd yoke portion is arranged in the position corresponding to the border area of the 1st magnetic pole portion and an insulating layer, for example.

[0037] Moreover, by the thin film magnetic head or its manufacture method of this invention, the 1st magnetic pole portion and the 1st yoke portion are formed by the separate layer, for example.

[0038] Mor over, by th thin film magnetic head or its manufactur method of this inv ntion, the 2nd magnetic pol portion and the 2nd yok portion ar formed by on layer, for example.

[0039] Moreover, by the thin film magn tic head or its manufactur m thod of this inv ntion, it may arrange betwee a gap layer and th 2nd yoke portion, and betwe n betw n a gap layer and th 1st yok portion, a gap lay r, and the 2nd yoke portion, it may divid and a thin film coil may b arranged, for example.

[0040] Mor over, by th manufactur method of th thin film magnetic h ad of this inv ntion, at the 1st proc ss, after forming the 1st magn tic layer, an insulating layer is formed and flatt ning pr cessing of the upp r surfac of

the 1st magnetic layer and an insulating layer is carried out after that, for example.
[0041]
[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained in detail with reference to a drawing.
[the gestalt of operation of the 1st of this invention] — with reference to drawing 1 or drawing 8 , the manufacture method of the compound-die thin film magnetic head as the manufacture method of the thin film magnetic head concerning the gestalt of operation of th 1st of this invention is explained first In addition, in drawing 1 or drawing 6 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to th pneumatic bearing side of a magnetic pole portion.
[0042] By the manufacture method concerning the gestalt of this operation, first, as shown in drawing 1 , the insulating layer 2 which consists of an alumina (aluminum 2O3) is deposited by the thickness of about 5 micrometers on the substrate 1 which consists of ARUTIKKU (aluminum 2O3 and TiC). Next, the lower shield layer 3 for the reproducing heads which consists of a magnetic material, for example, a permalloy, is formed on an insulating layer 2 at the thickness of about 3 micrometers. The lower shield layer 3 uses for example, a photoresist film as a mask, and forms it alternatively on an insulating layer 2 by the galvanizing method. Next, although not illustrated, the insulating layer which consists of an alumina is ground to the whole until it forms in the thickness of 4-6 micrometers, for example, the lower shield layer 3 is exposed with CMP (chemical machinery polish), and flattening of the front face is carried out to it.
[0043] Next, as shown in drawing 2 , on the lower shield layer 3, the spatter deposition of an alumina or the CHITSU-ized aluminum is carried out at the thickness of 70-100nm, and the lower shield gap film 4 as an insulating layer is formed. Next, MR film for forming the MR element 5 for reproduction on the lower shield gap film 4 is formed in the thickness of dozens of nm. Next, a photoresist pattern is alternatively formed in the position which should form the MR element 5 on this MR film. At this time, the configuration which can perform a lift off easily, for example, a cross-section configuration, forms a T type photoresist pattern. Next, MR film is **********ed by ion milling by using a photoresist pattern as a mask, for example, the MR element 5 is formed. In addition, a GMR el ment is sufficient as the MR element 5, and the AMR element is sufficient as it. Next, the electrode layer 6 of the couple electrically connected to the MR element 5 is formed in the thickness of dozens of nm by using the photoresist pattern same on the lower shield gap film 4 as a mask. Next, the up shield gap film 7 as an insulating layer is formed on the lower shield gap film 4 and the MR element 5 at the thickness of 70-100nm, and the MR element 5 is laid underground in the shield gap film 4 and 7. Next, on the up shield gap film 7, it consists of a magnetic material and the yoke portion 8 of the lower [an up shield layer-cum-] magnetic pole layer (it is hereafter described as a lower magnetic pole layer.) used to the both sides of the reproducing head and a recording head is alternatively formed by the thickness of about 1.0-1.5 micrometers.
[0044] Next, as shown in drawing 3 , magnetic pole partial 18a of a lower magnetic pole layer and magnetic layer 18b for magnetic-path formation are alternatively formed by the thickness of 2.0-2.5 micrometers by the magnetic material on the yoke portion 8. With a pneumatic bearing side, the position of the edge of an opposite side forms the magnetic pole portion 18 so that it may come near the position of the edge of an opposite side with the pneumatic b aring side of the MR element 5. Using the material of NiFe (nickel:80 % of the weight, Fe:20 % of the weight) and NiF (nickel:45 % of the weight, Fe:55 % of the weight) which is high saturation-magnetic-flux-density material, magnetic pole partial 18a and magnetic layer 18b may be formed by the galvanizing method, and may be formed by th spatter using material, such as FeN, FeZrN, etc. which are high saturation-magnetic-flux-density material. In addition, you may use CoFe, Co system amorphous material, etc. which are high saturation-magnetic-flux-density material.
[0045] Next, the insulating layer 11 which consists of an alumina is formed in the whole by the thickness of about 3-4 micrometers. Next, for example by CMP, an insulating layer 11 is ground and flattening of the front face is carri d out until magnetic pole partial 18a and magnetic layer 18b are exposed. With the gestalt of this operation, the position of the border area of magnetic pole partial 18a and an insulating layer 11 turns into the throat height zero position TH0.
[0046] Next, as shown in drawing 4 , the record gap layer 9 which consists of an insulating material is formed by th thickness of 0.2-0.3 micrometers on an insulating layer 11, magnetic pole partial 18a, and magnetic layer 18b. G nerally as an insulating material used for the record gap layer 9, there are an alumina, alumimium nitride, silicon oxide system material, and silicon nitride system material.
[0047] Next, for magnetic-path formation, in the portion on magnetic layer 18b, the record gap layer 9 is **********ed partially and a contact hole 19 is formed.
[0048] Next, in the portion on an insulating layer 11, the thin film coil 12 of the 1st layer for the recording heads of an induction type is formed on the record gap layer 9 at the thickness of 1.5-2.0 micrometers.
[0049] Next, as shown in drawing 5 , a photoresist layer 13 is formed on the record gap layer 9 and a coil 12 at a predetermined pattern. Next, in order to carry out flattening of the photoresist lay r 13 top, it heat-tr ats at th temperature of 250 degreeC. Next, th thin film coil 14 of the 2nd layer is formed on a photoresist layer 13 at th thickness of 1.5-2.0 micrometers. Next, a photoresist layer 15 is form d on a photor sist layer 13 and a coil 14 at a predetermin d pattern. Next, in order to carry out flatt ning of the photor sist lay r 15 top, it heat-tr ats at th t mp ratur of 250 degr eC.
[0050] Next, as shown in drawing 6 , the up magnetic pol layer 16 which consists of a magnetic material for recording heads is formed on the record gap layer 9 and photoresist layers 13 and 15 at th thickn ss of about 2-4

micrometers. Besides, the section magnetic pole layer 16 contacted magnetic layer 18b through the contact hole 19, and is connect d magnetically. Using the material of NiFe (nickel:80 % of the weight, Fe:20 % of the weight) and NiFe (nickel:45 % of th weight, Fe:55 % of the weight) which is high saturation-magnetic-flux-density material, the up magnetic pole layer 16 may be formed by the galvanizing method, and may be formed by the spatter using material, such as FeN, F ZrN, etc. which are high saturation-magnetic-flux-density material. In addition, you may use CoFe, Co system amorphous material, etc. which are high saturation-magnetic-flux-density material. Moreover, it is good also as structure which laid the insulator layer of an inorganic system, and magnetic layers, such as a permalloy, on top of many layers for the up magnetic pole layer 16 because of an improvement of a RF property.

[0051] Next, the record gap layer 9 is alternatively **********ed by dry etching by using the up magnetic pole layer 16 as a mask. the dry etching at this time — for example, BCl2, Cl2, CF4, and SH6 etc. — reactive ion etching (RIE) using gas is used Next, it considers as trim structure as **********s about about 0.3-0.6 micrometers alternatively and showed magnetic pole partial 18a of a lower magnetic pole layer to drawing 6 (b), for example by argon ion milling. According to this trim structure, the increase in the effective width of recording track by the breadth of the magnetic flux generated at the time of the writing of a ** truck can be prevented. Next, on the up magnetic pole layer 16, the overcoat layer 17 which consists of an alumina is formed in the thickness of 20-40 micrometers, flattening of the front face is carried out, and the pad for electrodes which is not illustrated on it is formed. Finally, polish processing of a slider is performed, the pneumatic bearing side of a recording head and the reproducing head is formed, and the thin film magnetic head concerning the gestalt of this operation is completed.

[0052] With the gestalt of this operation, a lower magnetic pole layer (8 18a) is equivalent to the 1st magnetic layer in this invention, and the up magnetic pole layer 16 is equivalent to the 2nd magnetic layer in this invention.

[0053] The plan of the thin film magnetic head which drawing 7 requires for the gestalt of this operation manufactured as mentioned above, and drawing 8 are the perspective diagrams of the thin film magnetic head concerning the gestalt of this operation. The overcoat layer 17 is omitted in any drawing. In addition, in drawing 7 , among drawing, in order that sign 18A may consider as trim structure, magnetic pole partial 18a of a lower magnetic pole layer expresses the portion into which it **********s.

[0054] As shown in drawing 7 and drawing 8 , the up magnetic pole layer 16 has magnetic pole partial 16a arranged at the pneumatic bearing side 20 side, and yoke partial 16b arranged in the position which counters coils 12 and 14. The width of face of magnetic pole partial 16a determines recording track width of face. The width of face of yoke partial 16b is larger than the width of face of magnetic pole partial 16a. The part by the side of magnetic pole partial 16a in yoke partial 16b is formed in the shape of [to which the magnetic pole partial 16a side becomes thin] a tap r.

[0055] With the gestalt of this operation, the insulating layer 11 which touches magnetic pole partial 18a of a lower magnetic pole layer and this forms a flat field in the record gap layer 9 side. Moreover, the position of the border ar a of magnetic pole partial 18a and an insulating layer 11 turns into the throat height zero position TH0. Moreover, with the gestalt of this operation, the root of the apex section formed of the photoresist layers 13 and 15 for insulating coils 12 and 14 is arranged in the pneumatic bearing side 20 rather than the throat height zero position TH0 in the position left 2-3 micrometers to the opposite side, for example.

[0056] The border area of magnetic pole partial 16a of the up magnetic pole layer 16 and yoke partial 16b is arranged on the position 9 which counters the flat field formed of magnetic pole partial 18a of a lower magnetic pole layer, and an insulating layer 11, i.e., a flat record gap layer. With the gestalt of this operation, especially the border area of magnetic pole partial 16a of the up magnetic pole layer 16 and yoke partial 16b is arranged in the position TH0 corresponding to the border area of magnetic pole partial 18a of a lower magnetic pole layer, and an insulating layer 11, i.e., a throat height zero position.

[0057] Moreover, with the gestalt of this operation, to the edge of magnetic pole partial 16a, the edge by the side of magnetic pole partial 16a of yoke partial 16b of the up magnetic pole layer 16 made the predetermined angle, and has spread to the crosswise outside. As for a predetermined angle, it is desirable that it is 90 degrees substantially. Her , the design value in the case of patterning of the up magnetic pole layer 16 is a meaning of 90 degrees, and "it is 90 degrees substantially" contains, when it shifts from 90 degrees somewhat by collapse of a photoresist pattern tc.

[0058] Thus, with the gestalt of this operation, since the border area of magnetic pole partial 16a of the up magnetic pol layer 16 and yoke partial 16b is arranged on a flat field, magnetic pole partial 16a which determines recording track width of face can be formed with a sufficient precision. Moreover, since the position of the border area of magnetic pole partial 16a of the up magnetic pole layer 16 and yoke partial 16b has separated about 2-3 micrometers from the root of the apex section, influence's of the reflected light of the direction of slant from the apex section in a photolithography process to the photoresist pattern for forming magnetic pole partial 16a and a longitudinal direction decreases, and becomes possible [forming magnetic pole partial 16a with a sufficient precision also from this point]. Therefore, according to the gestalt of this operation, even if recording track width of face becom s small less than [submicron order or it], exact control of magn tic pol width of face is attained.

[0059] moreover — the g stalt of this operation — th edg by th sid of magnetic pole partial 16a of yok partial 16b of th up magnetic pol layer 16 — th dg of magnetic pol partial 16a — rec iving — a predetermin d angle — 90 degrees was made preferably and it has spr ad to the crosswise outside Th r by, according to th g stalt of this operation, wh n magnetic pol width of face is mad small, more exact control of magn tic pol width of face is attained. The reason is explained below.

[0060] In case th up magnetic pole layer 16 is formed, according to a photolithography process, using a mask, a

photoresist is exposed alternatively and carries out patterning. In this case, the reflected light of the direction of slant from the apex section and a longitudinal direction had become a problem conventionally. With the gestalt of this operation, [near th throat height zero position TH0], the up magnetic pole layer 16 is formed so that the edge may spread on the crosswis outside. Therefore, the great portion of reflected light of the direction of slant from the ap x section and a longitudinal direction can reduce the influence which it has on the field for stopping reaching to the field for forming magnetic pole partial 16a, and the reflected light of the direction of slant from the apex section and a longitudinal direction forming magnetic pole partial 16a from the position of the edge which spreads on the crosswise outside. Consequently, it can suppress that the width of face of the photoresist pattern in the field for forming magnetic pole partial 16a spreads.

[0061] Thus, according to the gestalt of this operation, when magnetic pole width of face is made small, magnetic pole partial 16a which has fixed width of face can be formed with a sufficient precision.

[0062] Moreover, throat height is decided by the gestalt of this operation in the border area of magnetic pole partial 18a of not the photoresist layer surrounding a coil but a lower magnetic pole layer, and the insulating layer 11 using th alumina etc. Magnetic pole partial 18a can be correctly formed by patterning for example, by the galvanizing method. Therefore, throat height can be made uniform about two or more head elements arranged by the single ti r within the wafer. Moreover, magnetic pole partial 18a does not expand in the case of heat treatment of the photoresist layer for insulating a coil. Furthermore, since the circumference is enclosed by the insulating layer 11, in case magnetic pole partial 18a **********s by ion milling, magnetic pole partial 18a does not deform it for the se d layer of a coil. Therefore, the position of the border area of magnetic pole partial 18a and an insulating layer 11 is not changed. Thus, according to the gestalt of this operation, even when the throat height of submicron order or th order not more than it is required, it can become possible to form throat height with a uniformly sufficient precision, and the yield of a product can be raised.

[0063] Moreover, according to the gestalt of this operation, since the border area of magnetic pole partial 16a of the up magnetic pole layer 16 and yoke partial 16b has been arranged in the throat height zero position TH0, volume of a magnetic layer [near the throat height zero position TH0] can be enlarged, and it becomes possible to prevent the saturation of magnetic flux / near the throat height zero position TH0]. Therefore, according to the gestalt of this operation, when magnetic pole width of face is made small, sufficient over-writing property can be acquired. Without saturating magnetic flux on the way by forming magnetic pole partial 16a of the up magnetic pole layer 16, and magnetic pole partial 18a of a lower magnetic pole layer especially using high saturation-magnetic-flux-density material, a magnetic pole portion can be reached effectively and an efficient recording head with little loss of magnetomotive force can be realized.

[0064] Moreover, according to the gestalt of this operation, since the detailed up magnetic pole layer 16 can be formed in one layer, a manufacturing cost can be reduced.

[0065] Moreover, since the insulating layer 11 of the inorganic system from which thin and sufficient isolation voltage is obtained is formed between coils 12 and 14 and the yoke portion 8 of a lower magnetic pole layer according to the gestalt of this operation, while the insulation between coils 12 and 14 and a lower magnetic pole layer can be raised and ********** can do the yield, the leakage of the magnetic flux from coils 12 and 14 can b reduced.

[0066] By the way, the distance between the periphery edge of a coil and a throat height zero position was large by existence of the ramp of a photoresist pattern which is arranged conventionally at the coil bottom and determines throat height. On the other hand, according to the gestalt of this operation, since the coil 12 is formed on the flat record gap layer 9, there is no bird clapper greatly [the distance between the periphery edge of a coil and a throat height zero position] as mentioned above. Therefore, according to the gestalt of this operation, magnetic-path length can be shortened and it becomes possible to shorten magnetic-path length about 20% [the case where th photoresist pattern which determines throat height as the coil bottom exists]. Consequently, it becomes possibl t rais a RF property.

[0067] With reference to [the gestalt of operation of the 2nd of this invention] next drawing 9 , or drawing 12 , th gestalt of operation of the 2nd of this invention is explained. In addition, in drawing 9 or drawing 12 , (a) shows a cross section perpendicular to a pneumatic bearing side, and (b) shows the cross section parallel to the pneumatic bearing side of a magnetic pole portion.

[0068] As shown in drawing 9 by the manufacture method of the thin film magnetic head concerning the gestalt of this operation, the process to formation of the yoke portion 8 of a lower magnetic pole layer is the same as the gestalt of the 1st operation. In the gestalt of this operation, as shown in drawing 10 after that, magnetic layer 18b for magnetic pole partial 18a of a lower magnetic pole layer and magnetic-path formation by the magnetic material is alternatively formed by the thickness of 2.0-2.5 micrometers on the yoke portion 8.

[0069] Next, insulating-layer 11a which consists of an alumina is formed on the yoke portion 8 at the thickness of about 0.3-0.7 micrometers. Next, the thin film coil 12 of the 1st layer is formed on insulating-layer 11a at the thickness of 1.5-2.0 micrometers. Next, the insulating lay r 11 which consists of an alumina is formed in th whole by the thickn ss of about 3-5 micrometers. Next, for example by CMP, an insulating layer 11 is ground and flattening of the front fac is carried out until magnetic pol partial 18a and magnetic lay r 18b ar exposed. With the gestalt of this operation, the position of th border ar a of magnetic pole partial 18a and insulating-layer 11a , turns into th throat height zero position TH0.

[0070] N xt, as shown in drawing 11 , the r cord gap layer 9 which consists of an insulating material is formed by the thickness of 0.2-0.3 micrometers on an insulating lay r 11, magnetic pole partial 18a, and magnetic layer 18b.

Next, for magnetic-path formation, in the portion on magnetic layer 18b, the record gap layer 9 is **********ed partially and a contact hole 19 is formed. Next, the thin film coil 14 of the 2nd layer is formed on the record gap lay r 9 at the thickness of 1.5-2.0 micrometers.

[0071] Next, as shown in drawing 12 , a photoresist layer 15 is formed on the record gap layer 9 and a coil 14 at a predetermined pattern. Next, in order to carry out flattening of the photoresist layer 15 top, it heat-treats at the temperature of 250 degreeC.

[0072] Next, the up magnetic pole layer 16 which consists of a magnetic material for recording heads is formed on the record gap layer 9 and a photoresist layer 15 at the thickness of about 2-4 micrometers. Besides, the section magnetic pole layer 16 contacted magnetic layer 18b through the contact hole 19, and is connected magnetically.

[0073] Next, the record gap layer 9 is alternatively **********ed by dry etching by using the up magnetic pole layer 16 as a mask. Next, it considers as trim structure as **********s about about 0.3-0.6 micrometers alternatively and showed magnetic pole partial 18a of a lower magnetic pole layer to drawing 12 (b), for example by argon ion milling. Next, on the up magnetic pole layer 16, the overcoat layer 17 which consists of an alumina is formed in th thickness of 20-40 micrometers, flattening of the front face is carried out, and the pad for electrodes which is not illustrated on it is formed. Finally, polish processing of a slider is performed, the pneumatic bearing side of a recording head and the reproducing head is formed, and the thin film magnetic head concerning the gestalt of this operation is completed.

[0074] Also in the gestalt of this operation, the up magnetic pole layer 16 has magnetic pole partial 16a arranged at a pneumatic bearing side side, and yoke partial 16b arranged in the position which counters coils 12 and 14. The configuration of magnetic pole partial 16a and yoke partial 16b is the same as that of the gestalt of the 1st operation.

[0075] With the gestalt of this operation, magnetic pole partial 18a of a lower magnetic pole layer and insulating lay rs 11a and 11 form a flat field in the record gap layer 9 side. Moreover, the position of the border area of magnetic pole partial 18a and insulating-layer 11a turns into the throat height zero position TH0. Moreover, with th gestalt of this operation, the root of the apex section formed of the photoresist layer 15 for insulating a coil 14 is arranged with the pneumatic bearing side rather than the throat height zero position TH0 in the position left 2-3 micrometers to the opposite side, for example.

[0076] The border area of magnetic pole partial 16a of the up magnetic pole layer 16 and yoke partial 16b is arranged on the position 9 which counters the flat field formed of magnetic pole partial 18a of a lower magnetic pole layer, and insulating layers 11a and 11, i.e., a flat record gap layer. With the gestalt of this operation, especially the border area of magnetic pole partial 16a of the up magnetic pole layer 16 and yoke partial 16b is arranged in the position TH0 corresponding to the border area of magnetic pole partial 18a of a lower magnetic pole layer, and insulating-layer 11a, i.e., a throat height zero position.

[0077] According to the gestalt of this operation, since the height of the apex section becomes low compared with the gestalt of the 1st operation, it becomes possible to form the up magnetic pole layer 16 with a more sufficient pr cision.

[0078] Moreover, according to the gestalt of this operation, since the record gap layer 9 and the insulating layer 11 which can be formed by arbitrary thickness can be inserted between the coil 12 of the 1st layer, and the coil 14 of the 2nd layer, isolation voltage between these coils 12 and 14 can be enlarged.

[0079] Moreover, since according to the gestalt of this operation the detailed up magnetic pole layer 16 can be form d in one layer while there are few CMP processes, a manufacturing cost can be reduced.

[0080] The composition of others in the gestalt of this operation, the operation, and the effect are the same as the gestalt of the 1st operation.

[0081] In addition, this invention is not limited to the gestalt of each above-mentioned implementation, but various change is possible for it. For example, in the gestalt of each above-mentioned implementation, although the up magnetic pole layer 16 was formed in one layer, you may form magnetic pole partial 16a and yoke partial 16b in a separate layer.

[0082] Moreover, although the gestalt of each above-mentioned implementation explained the thin film magnetic head of the structure which read to the base side, formed MR element of business, and carried out the laminating of th induction-type MAG sensing element for writing on it, you may make this built-up sequence reverse.

[0083] That is, it may write in a base side, the induction-type MAG sensing element of business may be formed, and MR lement for reading may be formed on it. Such structure is realizable by forming in a base side by using as a lower magnetic pole layer the magnetic film which has the function of the up magnetic pole layer shown in the gestalt of the above-mentioned implementation for example, and forming the magnetic film which has the function of th lower magnetic pole layer it was indicated to the gestalt of the above-mentioned implementation that countered it as an up magnetic pole layer through a record gap film. In this case, it is desirable to make the up magnetic pole lay r of an induction-type MAG sensing element and the lower shield layer of MR element make it serve a double purpose.

[0084] In addition, it is desirable to us the base in which th crevice was form d, in such th thin film magnetic head of structur . And th size of th thin film magnetic h ad itself can b furth r r duction-ized by forming th coil section in the crevic of a bas .

[0085] Furthermor , it is good also considering all the insulating layers formed as a diff rent gestalt between each thin film coil which constitutes the coil section of an induction-type MAG sensing lem nt as an inorganic insulating lay r.

[0086] Moreover, this invention can be equipped only with an induction-type MAG sensing element, and can apply it also to the thin film magnetic head which performs reading and writing by this induction-type MAG sensing element.
[0087]
[Eff ct of the Invention] As explained above, according to the manufacture method of the thin film magnetic head according to claim 1 to 8 or the thin film magnetic head according to claim 9 to 17 While the 1st magnetic pole portion and insulating layer of a magnetic layer determine throat height, [1st] The 2nd magnetic pole portion which has the width of face which forms a flat field and determines recording track width of face as a gap layer side, Since the border area with the 2nd yoke portion which has larger width of face than the 2nd magnetic pole portion has been arranged in the position which counters the flat field formed of the 1st magnetic pole portion and insulating layer When magnetic pole width of face is made small, while becoming possible to acquire exact control of magnetic pol width of face, and sufficient over-writing property Since the 1st magnetic pole portion and insulating layer which form a flat field determine throat height, the effect that exact control of throat height is attained is done so.
[0088] Moreover, since the edge by the side of the 2nd [of the 2nd yoke portion] magnetic pole portion makes a predetermined angle and it was made to spread to a crosswise outside to the edge of the 2nd magnetic pole portion according to the manufacture method of the thin film magnetic head according to claim 2 or 3 or the thin film magnetic head according to claim 10 or 11, the effect that exact control of magnetic pole width of face is attained further more is done so.
[0089] Since the predetermined angle was especially made into 90 degrees substantially according to the manufacture method of the thin film magnetic head according to claim 3 or the thin film magnetic head according to claim 11, the effect that exact control of magnetic pole width of face is attained much more is done so.
[0090] Moreover, according to the manufacture method of the thin film magnetic head according to claim 6 or the thin film magnetic head according to claim 14, since the 2nd magnetic pole portion and the 2nd yoke portion were formed in one layer, the effect that a manufacturing cost can be reduced is further done so.

[Translation done.]